Arthroscopic hip surgery: frequency of postoperative mr arthrographic findings in asymptomatic and symptomatic patients

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Abstract: Purpose To determine and compare the frequency of imaging abnormalities in asymptomatic and symptomatic patients after arthroscopic hip surgery. Materials and Methods This study was approved by the institutional review board. Informed consent was obtained from all patients. Thirty-four patients (17 asymptomatic and 17 symptomatic patients) underwent 1.5-T magnetic resonance (MR) arthrography of the hip 1 year after arthroscopic treatment of femoroacetabular impingement. Two readers independently analyzed all MR arthrographic images for the presence of abnormal imaging findings, including capsular adhesions at the femoral neck, obliteration of the paralabral sulcus, labral defects, and defects of the hip capsule in several anatomic positions (anterior to posterior). Postoperative findings were compared with linear and generalized linear mixed-effects regression models. Results Capsular adhesions at the anterior femoral neck were present in 12 of the 34 patients (35%), and there were no differences between the groups or readers (P = .99). The paralabral sulcus was obliterated in at least one anatomic location in 94% (reader 1, 32 of 34 patients) and 100% (reader 2, 34 of 34 patients) of patients (P = .99). Residual labral tears were detected in 35% of asymptomatic patients (six of 17 patients) and 41% of symptomatic patients (seven of 17 patients) by reader 1 and in 53% of asymptomatic and symptomatic patients (nine of 17 patients in each group) by reader 2, without significant differences between the groups (P = .81). Defects of the hip capsule were more common in asymptomatic patients (77% [13 of 17 patients] for reader 1 and 53% [nine of 17 patients] for reader 2) than in symptomatic patients (59% [10 of 17 patients] for reader 1 and 47% [eight of 17 patients] for reader 2), but without significant differences (P = .33). Conclusion Obliteration of the paralabral sulcus was the most frequent finding after arthroscopic hip surgery in both asymptomatic and symptomatic patients, and capsular adhesions at the anterior femoral neck were present in 35% of patients in both groups. (©) RSNA, 2016.

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Radiology

Arthroscopic Hip Surgery: Frequency of Postoperative MR Arthrographic Findings in Asymptomatic and Symptomatic Patients[1]

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Results: Capsular adhesions at the anterior femoral neck were present in 12 of the 34 patients (35%), and there were no differences between the groups or readers (P = .99). The paralabral sulcus was obliterated in at least one anatomic location in 94% (reader 1, 32 of 34 patients) and 100% (reader 2, 34 of 34 patients) of patients (P = .99). Residual labral tears were detected in 35% of asymptomatic patients (six of 17 patients) and 41% of symptomatic patients (seven of 17 patients) by reader 1 and in 53% of asymptomatic and symptomatic patients (nine of 17 patients in each group) by reader 2, without significant differences between the groups (P = .81). Defects of the hip capsule were more common in asymptomatic patients (77% [13 of 17 patients] for reader 1 and 53% [nine of 17 patients] for reader 2) than in symptomatic patients (59% [10 of 17 patients] for reader 1 and 47% [eight of 17 patients] for reader 2), but without significant differences (P = .33).

Conclusion: Obliteration of the paralabral sulcus was the most frequent finding after arthroscopic hip surgery in both asymptomatic and symptomatic patients, and capsular adhesions at the anterior femoral neck were present in 35% of patients in both groups.

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Femoroacetabular impingement (FAI) is a common reason for hip pain and is associated with limited range of motion, lesions of the labrum and articular cartilage, and early osteoarthritis (1,2). Open surgery and, in recent years, arthroscopic surgery have been successfully established for surgical treatment of FAI in adolescents and adults (3,4). Surgery can correct the underlying osseous abnormalities (eg, anterolateral acetabular overcoverage of the femoral head and osseous deformities at the femoral head–neck junction) and thus provide improvement in hip range of motion and resolve groin pain (5–7). In addition, cartilage and labral lesions can be addressed during surgery. However, some patients have persistent or recurrent groin pain after hip surgery. Possible reasons for persistent or recurrent groin pain after surgery include inadequate correction of the underlying osseous deformity, progressive cartilage deterioration, labral tears, fractures, avascular necrosis, capsular defects, and intraarticular adhesions (8–11).

In patients with residual symptoms after FAI surgery, a variety of clinical and imaging findings are evaluated to determine further treatment and whether a conservative approach or even revision surgery should be chosen (9,12,13).

To date, very little is known about the relevance of postoperative imaging abnormalities after arthroscopic hip surgery even though a number of patients with persistent or recurrent postoperative pain routinely undergo magnetic resonance (MR) arthrography of the hip joint to either confirm or exclude suspected intraarticular abnormalities. To our knowledge, there is only one original study on the postoperative morphologic characteristics of the labrum in patients suspected of having recurrent labral tears (14). Other than that, the available literature consists of reviews, surgical reports, and case reports. Therefore, it would be beneficial to investigate the prevalence of postoperative abnormalities seen at MR arthrography in both patients without and patients with symptoms after hip arthroscopy.

Thus, the goal of our study was to compare the frequency of a variety of postoperative imaging findings at MR arthrography of the hip in asymptomatic and symptomatic patients.

Advances in Knowledge

- Postoperative changes after arthroscopic surgery for femoroacetabular impingement are seen frequently at MR arthrography of the hip and are evenly distributed in asymptomatic and symptomatic patients.
- Anterior femoral neck adhesions occur in a substantial number of individuals 1 year after hip arthroscopy in both asymptomatic patients (six of 17 patients, 35%) and symptomatic patients (six of 17 patients, 35%) (P = .99).
- Residual labral tears are present in the same frequency 1 year after hip arthroscopy in asymptomatic patients (35% [six of 17 patients] for reader 1 and 53% [nine of 17 patients] for reader 2) and symptomatic patients (41% [seven of 17 patients] for reader 1 and 53% [nine of 17 patients] for reader 2) (P = .81).
- Defects of the anterior hip capsule are common postoperative changes after hip arthroscopy, with a frequency of 53% (nine of 17 patients) and 77% (13 of 17 patients) in asymptomatic patients and 47% (eight of 17 patients) and 59% (10 of 17 patients) in symptomatic patients (P = .33).

Implication for Patient Care

- Because postoperative changes are frequent in asymptomatic and symptomatic patients after hip arthroscopy, MR arthrography alone is not helpful for deciding whether a patient with residual symptoms should undergo conservative treatment or revision hip surgery.

Materials and Methods

Study Population

This study was approved by the institutional ethical review board, and written informed consent was obtained from all patients. Our study features both asymptomatic and symptomatic patients after arthroscopic hip surgery at Balgrist University Hospital in Zurich, Switzerland.

Asymptomatic patients.—Data in asymptomatic patients were acquired from 2008 to 2010 for a prospective orthopedic study with a different study question (4), where 38 patients who underwent hip surgery for FAI (either arthroscopy or open surgery) underwent postoperative MR arthrography 1–2 years later (mean, 12.9 months) as part of the study protocol. For our study, only the patients who had undergone arthroscopic surgery, had received MR arthrography as scheduled, and had a pain assessment score of 1.0 or less (0 = minimum score and 10 = maximum score) at the time of the MR arthrography were included. This resulted in a group of 17 asymptomatic patients with a mean pain score of 0.1 (range, 0.0–1.0). All 17 individuals were part of the study mentioned earlier (4), but the intraarticular abnormalities seen at MR arthrography have not yet been reported on.

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Abbreviations:
FAI = femoroacetabular impingement
trueFISP = true fast imaging with steady-state precession

Author contributions:
Guarantors of integrity of entire study, C.H.O.K., R.S.; study concepts/study design or data acquisition or data analysis/interpretation, all authors; manuscript drafting or manuscript revision for important intellectual content, all authors; manuscript final version approval, all authors; agrees to ensure any questions related to the work are appropriately resolved, all authors; literature research, C.H.O.K., T.J.D., P.O.Z., C.W.A.P., R.S.; clinical studies, C.H.O.K., T.J.D., C.D., C.W.A.P.; statistical analysis, C.H.O.K.; and manuscript editing, all authors

Conflicts of interest are listed at the end of this article.

Pain assessment was performed as part of the standardized Western Ontario and McMaster Universities Arthritis Index questionnaire, or WOMAC (15), which includes a subjective assessment of hip pain. The questionnaire consists of five items addressing pain during the night, while walking, while climbing stairs, when lying or sitting, and while standing. The items were scored with a rating system with five grades, as follows: 0, no pain; 2.5, mild pain; 5, moderate pain; 7.5, severe pain; and 10, extreme pain. The mean of these five items was calculated with a range from 0 points (painless) to 10 points (extreme pain). For our study, we selected asymptomatic patients with a pain score of 1.0 or less and symptomatic patients with a pain score of at least 2.5.

Symptomatic patients.—Data from symptomatic patients were based on a consecutive series of 384 patients who underwent arthroscopic hip surgery for FAI at our institution during a 5-year period (2005–2011). Of these 384 patients, only those who underwent postoperative MR arthrography 1–2 years after surgery (mean, 13.7 months) and had a pain assessment score of at least 2.5 as part of the Western Ontario and McMaster Universities Arthritis Index questionnaire at the time of MR arthrography (0 = minimum score, 10 = maximum score) were included. This resulted in a group of 17 symptomatic patients with a mean pain score of 5.4 (range, 2.5–9.0). These 17 patients have not been reported before in a publication.

The asymptomatic group (n = 17) had a mean pain score of 0.1 (range, 0.0–1.0) and consisted of five women (29%) and 12 men (71%) with a mean age of 27.1 years (range, 21–45 years). The symptomatic group (n = 17) consisted of 10 women (59%) and seven men (41%) with a mean age of 34.1 years (range, 16–51 years).

Surgical Techniques

For hip arthroscopy, the patients were positioned and portals were placed following the Byrd procedure by using fluoroscopic guidance. Acetabular rim trimming and osteochondroplasty were judged appropriate when, by means of dynamic examination and visualization, impingement-free internal hip rotation of at least 30° in 90° flexed hip position was obtained. Partial labrum resection was performed during surgery where appropriate, and no repeat fixation of a detached labrum was performed.

MR Arthrography

For MR arthrography, intraarticular contrast material was injected in a standardized manner in all patients under fluoroscopic guidance. In addition to 8–10 mL of the MR contrast agent (gadopentetate dimeglumine, 2 mmol/mL [Magnevist; Bayer Healthcare, Berlin, Germany]), 1 mL of a local anesthetic (lidocaine hydrochloride 2% [Rapidocaine; Sintetica, Mendrisio, Switzerland]), and 1 mL of an iodinated contrast agent (iopamidol, 200 mg/mL [Iopamiro; Bracco, Milan, Italy]) were administered in the hip joint. The iodinated contrast agent was administered to verify the correct intraarticular application under fluoroscopic guidance. The MR examination was started within 15 minutes after the contrast agent injection.

MR imaging was performed with a 1.5-T unit (Magnetom Avanto; Siemens Healthcare, Erlangen, Germany) with a four-channel phased-array matrix surface body coil (with the coil placed over the hip of the patient in supine position) and a six-channel matrix spine coil, which was integrated in the patient table.

The MR arthrography protocol included the following sequences: *(a)* coronal T1-weighted fast spin-echo imaging (repetition time msec/echo time msec, 605/13; field of view, 160 × 160 mm; matrix, 512 × 256; and section thickness, 3 mm), *(b)* coronal proton density–weighted fast spin-echo imaging with fat suppression (3540/39; field of view, 160 × 160 mm; matrix, 256 × 256; section thickness, 3 mm), *(c)* sagittal three-dimensional water-excitation double-echo steady-state imaging (25.16/8.56; field of view, 150 × 150 mm; matrix, 256 × 192; section thickness, 1.7 mm), and *(d)* transverse oblique three-dimensional water-excitation true fast imaging with steady-state precession (trueFISP) parallel to the longitudinal axis of the femoral neck (12.4/5.45; field of view, 170 × 170 mm; matrix, 384 × 384; section thickness, 1.25 mm).

On the basis of this three-dimensional data set, additional secondary radial reformations along the longitudinal axis of the femoral neck as rotation axis were calculated.

Image Analysis

Two fellowship-trained musculoskeletal radiologists (C.H.O.K. and R.S., with 8 and 10 years of experience, respectively) independently analyzed the MR arthrographic images from all 34 patients. Images were evaluated in random order. Both readers were blinded to the clinical history of the patients and to whether a patient belonged to the asymptomatic or symptomatic group. The following characteristics were analyzed:

1. The presence of capsular adhesions at the anterior circumference of the femoral neck (Figs 1, 2) was noted when the capsule had a broad contact to the femoral neck. The broadness of these adhesions was measured (in millimeters) on transverse oblique images, with the measurement performed parallel to the bone surface of the anterior femoral neck.

2. The presence or obliteration of the paralabral sulcus between the labrum and the joint capsule was noted (Figs 3, 4) in addition to the presence of bandlike adhesions in the paralabral sulcus between the capsule and labrum (Figs 5, 6). The paralabral sulcus was assessed at the following positions: anterosuperior, superior, posterosuperior, and posterior. For the paralabral sulcus, we excluded the anterior position of the joint because the adjacent iliopsoas tendon compresses any paralabral sulcus that may be present in this position.

3. The presence or absence of the labrum after surgery was noted at the five following positions of the joint: anterior, anterosuperior, superior, posterosuperior, and posterior. If a labrum was present, its morphologic appearance was categorized as triangular (normal)

Figure 1

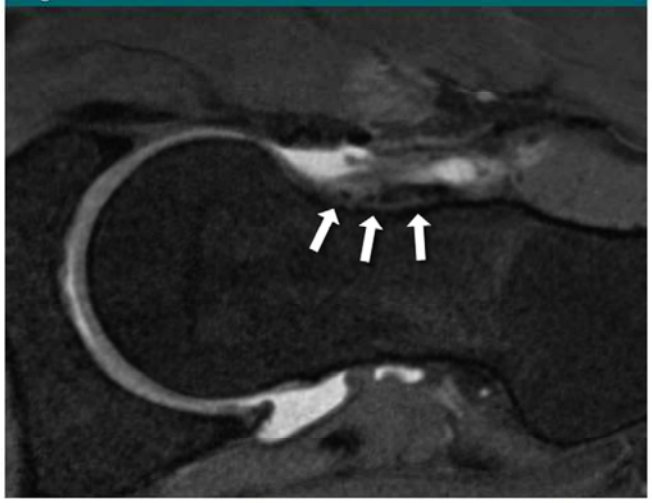

Figure 1: Anterior capsular adhesion at femoral neck in 27-year-old asymptomatic man after hip arthroscopy. Transverse oblique trueFISP image obtained at MR arthrography of left hip shows capsular adhesion (arrows) between anterior portion of joint capsule and femoral neck.

Figure 2

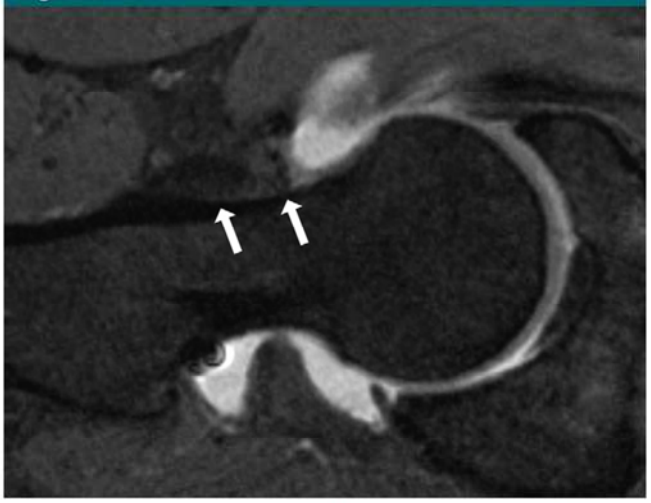

Figure 2: Anterior capsular adhesion at femoral neck in 39-year-old symptomatic woman after hip arthroscopy. Transverse oblique trueFISP image obtained at MR arthrography of right hip shows capsular adhesion (arrows) between anterior portion of joint capsule and femoral neck.

Figure 3

Figure 3: Obliteration of superior paralabral sulcus in 30-year-old asymptomatic man after hip arthroscopy. Coronal T1-weighted image obtained at MR arthrography of left hip shows obliterated paralabral sulcus (thick arrow), with labrum broadly adhering to superior part of joint capsule. Image obtained before surgery (inset) shows normal paralabral sulcus (thin arrow).

Figure 4

Figure 4: Obliteration of superior paralabral sulcus in 23-year-old symptomatic man after hip arthroscopy. Coronal T1-weighted MR image obtained at MR arthrography of left hip shows obliterated paralabral sulcus (thick arrow). Image obtained before surgery (inset) shows normal paralabral sulcus (thin arrow).

or shortened. In addition, residual labral tears were recorded according to location (Figs 7, 8).

4. The presence and size (in millimeters) of anterior capsular defects were analyzed. A capsular defect was measured on sagittal images in the widest craniocaudal orientation.

5. The integrity of the acetabular and femoral cartilage was assessed and categorized as follows: 0, normal; 1, superficial cartilage defect (≤50% thickness); and 2, deep cartilage defect (>50% thickness). The cartilage was assessed at the following positions: anterior, anterosuperior, superior, posterosuperior, and posterior. For the femoral head cartilage,

Figure 5

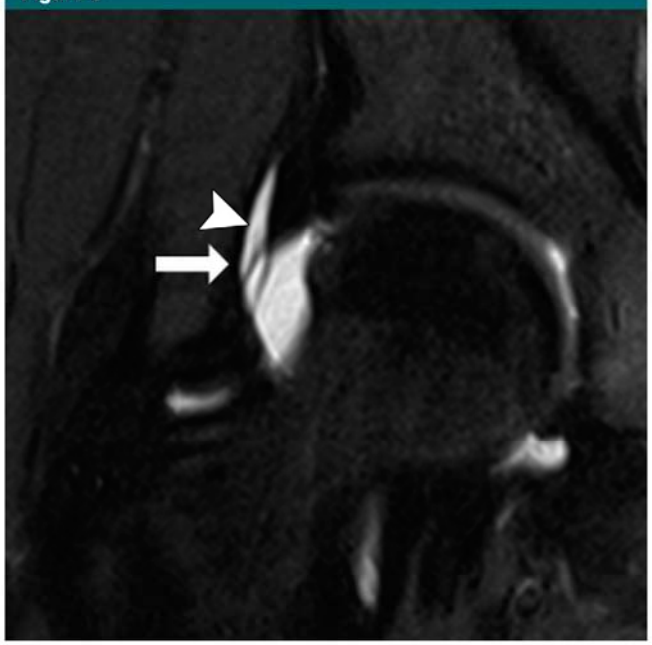

Figure 5: Bandlike adhesion of paralabral sulcus in 23-year-old asymptomatic woman after hip arthroscopy. Coronal proton density–weighted image obtained with fat suppression at MR arthrography of right hip shows bandlike adhesion (arrow) of superior paralabral sulcus (arrowhead).

Figure 6

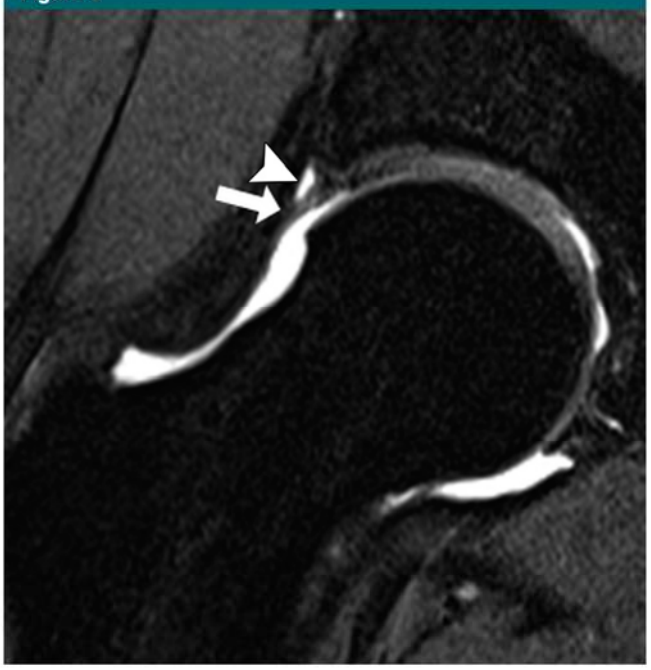

Figure 6: Bandlike adhesion of paralabral sulcus in 43-year-old symptomatic man after hip arthroscopy. Coronal proton density–weighted image obtained with fat suppression at MR arthrography of right hip shows bandlike adhesion (arrow) of superior paralabral sulcus (arrowhead).

an additional sixth position (inferior) was assessed.

6. Miscellaneous parameters evaluated included the presence of femoral or acetabular edema, femoral neck fractures, and avascular necrosis of the femoral head. The presence or absence of a fluid-filled iliopsoas bursa (Figs 7, 8) was noted and, if present, its maximal anteroposterior diameter was measured on transverse oblique images.

Statistical Analysis

Descriptive statistics were used to depict the prevalence of abnormal imaging findings in the two study groups, both on a per-patient basis and separately for each anatomic position. For continuous outcome variables, a random effects analysis of variance, with a random intercept model for readers and symptom group as independent variable, was used. For binary outcome variables, generalized linear mixed models were applied, again with a random intercept model for readers and symptom group as independent variable. For each of the models, estimated effects (mean differences for continuous outcomes, odds ratios for binary outcomes), their 95% confidence intervals, and P values were reported. Intraclass correlation coefficients were calculated as the ratio of the between-cluster variance to the total variance. These are reported for each of the mixed models. $P < .05$ was considered indicative of a statistically significant difference. Measure of agreement was calculated with κ values for categoric variables and with the intraclass correlation coefficient for continuous variables.

All analyses were performed with software (SPSS for Windows, release 21.0 [IBM, Chicago, Ill] and R for Windows [R Core Team 2015, R: A language and environment for statistical computing; R Foundation for Statistical Computing, Vienna, Austria *https://www.R-project.org/*.])

Results

Several imaging findings were frequently observed after arthroscopic hip surgery in both asymptomatic and symptomatic patients. Capsular adhesions at the anterior femoral neck (Figs 1, 2) were present in 35% of the asymptomatic and symptomatic patients (six of the 17 patients in each group), and there were no differences between the groups or between the two readers ($P = .99$) (Table 1). The width of the adhesions at the anterior femoral neck showed no statistically significant difference for both groups and both readers ($P = .12$) (Table 1).

The paralabral sulcus was obliterated (Figs 3, 4) or showed bandlike adhesions (Figs 5, 6) in at least one location in 94% of symptomatic and asymptomatic patients (16 of 17 patients in each group) for reader 1 and in 100% of symptomatic and asymptomatic patients (17 of 17 patients in each group) for reader 2, without statistically significant differences ($P = .99$) between the groups (Table 1). The distribution of the paralabral sulcus abnormalities for the different positions of the joint is shown in Table 2.

Figure 7

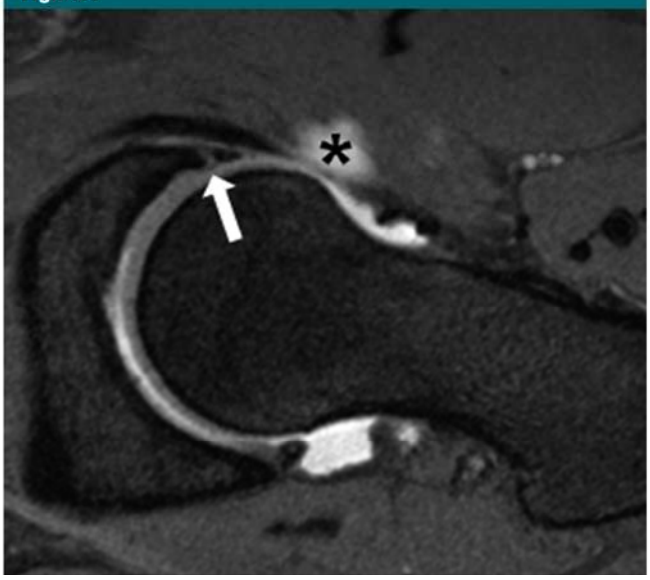

Figure 7: Residual tear of anterior labrum in 22-year-old asymptomatic man after hip arthroscopy. Transverse oblique trueFISP image obtained at MR arthrography of left hip shows anterior labral tear (arrow). Note also contrast material–filled lateral portion of iliopsoas bursa (*) anterior to joint capsule.

Figure 8

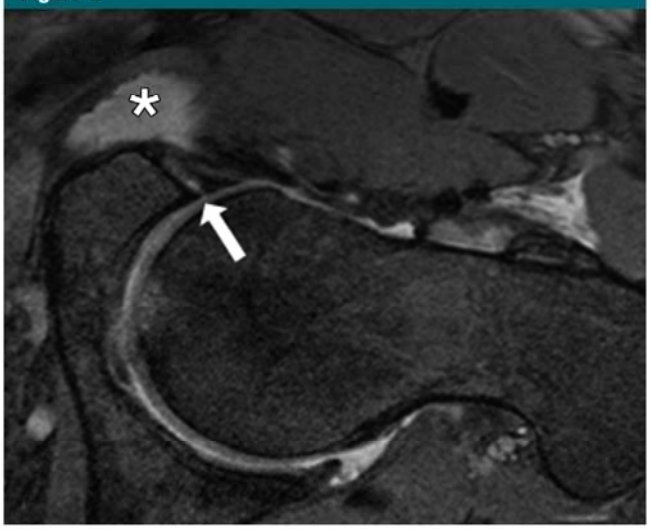

Figure 8: Residual tear of anterior labrum in 43-year-old symptomatic man after hip arthroscopy. Transverse oblique trueFISP image obtained at MR arthrography of left hip shows anterior labral tear (arrow). Note also contrast material–filled medial portion of iliopsoas bursa (*) anterior to joint capsule.

Table 1

Capsular and Paralabral Adhesions in Asymptomatic and Symptomatic Patients

	Reader 1*		Reader 2*			
Parameter	Asymptomatic Group ($n = 17$)	Symptomatic Group ($n = 17$)	Asymptomatic Group ($n = 17$)	Symptomatic Group ($n = 17$)	Estimate†	*P* Value
Adhesions at anterior femoral neck	35 (6)	35 (6)	35 (6)	35 (6)	1.0 (0.37, 2.70)	.99
Adhesion size (mm)‡	12.3 ± 5.4	16.2 ± 4.1	13.2 ± 6.8	15.5 ± 3.0	3.08 (−0.76, 6.93)	.12
Obliteration of paralabral sulcus or bandlike adhesions of the paralabral sulcus (in any position)	94 (16)	94 (16)	100 (17)	100 (17)	1.0 (0.06, 16.67)	.99

* Except where indicated, data are percentages, with numbers of patients in parentheses.

† Estimates are odds ratios for categoric variables and estimated mean difference for continuous variable. Numbers in parentheses are 95% confidence intervals.

‡ Data are means ± standard deviations.

Residual labral tears (Figs 7, 8) were detected in 35% of asymptomatic patients (six of 17 patients) and 41% of symptomatic patients (seven of 17 patients) by reader 1 and in 53% of asymptomatic and symptomatic patients (nine of 17 patients in each group) by reader 2 (Table 3), without a statistically significant difference ($P = .81$). The distribution of labral tears for each anatomic position is shown in Table 4.

The labrum was missing due to surgical resection in at least one location more often in asymptomatic than in symptomatic patients, but without a statistically significant difference between the two groups ($P = .08$) (Table 3).

If a labrum was present at any given anatomic location, its morphologic appearance was further categorized. The labrum had a shortened appearance in at least one anatomic location in 82% of asymptomatic and symptomatic patients (14 of 17 patients in each group) for reader 1 and in 88% of asymptomatic and symptomatic patients (15 of 17 patients in each group) for reader 2 (Table 3).

At all the locations where the labrum was not fully resected, the

labrum showed a normal triangular appearance in 18% of both asymptomatic and symptomatic patients (three of 17 patients in each group) for reader 1 and in 12% of both asymptomatic and symptomatic patients (15 of 17 patients in each group) for reader 2. No statistically significant differences in the morphologic characteristics of the labrum were found between the groups for either reader (P = .53 for both readers).

Defects of the anterior hip capsule were more common in asymptomatic than in symptomatic patients, with frequencies of 77% in asymptomatic patients (13 of 17 patients) and 59% in symptomatic patients (10 of 17 patients) for reader 1 and 53% (nine of 17 patients) and 47% (eight of 17 patients), respectively, for reader 2 (Table 3). Those frequencies also showed no statistically significant differences between both groups (P = .33) (Table 3).

The frequency of acetabular cartilage defects was 12% in asymptomatic patients (two of 17 patients) and 24% in symptomatic patients (four of 17 patients) for reader 1 and 41% (seven of 17 patients) for both groups for reader 2. There was no statistically significant difference with regard to the presence of cartilage defects of the acetabulum for asymptomatic and symptomatic patients (P = .18).

Cartilage defects of the femoral head were less frequent and were observed in 12% of asymptomatic and symptomatic patients (two of 17 patients in each group) by reader 1 and in 24% of asymptomatic patients (four of 17 patients) and 12% of symptomatic patients (two of 17 patients) by reader 2, without a statistically significant difference (P = .5) (Table 2). The distribution of acetabular and femoral cartilage defects is shown in Table 5.

Edema of the acetabulum or femoral head was rare and thus there were no statistically significant differences between both groups: Edema of the acetabulum was found in none of the asymptomatic patients and in only one of the 17 symptomatic patients (6%) by both readers (P = .96). Edema of the femoral head was uncommon and was observed in 6% of asymptomatic patients (one of 17 patients) and 12%

Table 2

Distribution of the Obliteration and Bandlike Adhesions of the Paralabral Sulcus

	Reader 1		Reader 2	
Parameter	Asymptomatic Group (n = 17)	Symptomatic Group (n = 17)	Asymptomatic Group (n = 17)	Symptomatic Group (n = 17)
Obliteration of paralabral sulcus				
Anterosuperior	71 (12)	65 (11)	94 (16)	82 (14)
Superior	82 (14)	71 (12)	88 (15)	65 (11)
Posterosuperior	29 (5)	18 (3)	59 (10)	29 (5)
Posterior	6 (1)	12 (2)	6 (1)	6 (1)
Bandlike adhesions				
Anterosuperior	6 (1)	6 (1)	6 (1)	0 (0)
Superior	6 (1)	12 (2)	12 (2)	29 (5)
Posterosuperior	0 (0)	6 (1)	6 (1)	6 (1)
Posterior	0 (0)	0 (0)	0 (0)	0 (0)

Note.—Data are percentages, with numbers of patients in parentheses. The anterior position was excluded from the analysis owing to the overlying iliopsoas tendon, which compresses any potential anterior paralabral sulcus.

Table 3

Labrum Findings, Cartilage Defects, and Capsular Defects in Asymptomatic and Symptomatic Patients

	Reader 1*		Reader 2*			
Parameter	Asymptomatic Group (n = 17)	Symptomatic Group (n = 17)	Asymptomatic Group (n = 17)	Symptomatic Group (n = 17)	Estimate†	P Value
Residual labral tears	35 (6)	41 (7)	53 (9)	53 (9)	1.13 (0.43, 2.93)	.81
Shortened labrum	82 (14)	82 (14)	88 (15)	88 (15)	0.67 (0.19, 2.35)	.53
Missing/absent labrum	71 (12)	47 (8)	77 (13)	59 (10)	2.47 (0.89, 6.83)	.08
Acetabular cartilage defects	12 (2)	24 (4)	41 (7)	41 (7)	2.08 (0.71, 6.11)	.18
Femoral cartilage defects	12 (2)	12 (2)	24 (4)	12 (2)	0.62 (0.16, 2.44)	.50
Capsular defects	77 (13)	59 (10)	53 (9)	47 (8)	0.61 (0.23, 1.63)	.33
Mean size of capsular defects (mm)‡	23.2 ± 9.1	20.6 ± 6.5	22.2 ± 8.7	26.9 ± 6.2	0.57 (−4.42, 5.56)	.82

* Except where indicated, data are percentages, with numbers of patients in parentheses.

† Estimates are odds ratios for categoric variables and estimated mean difference for continuous variable. Numbers in parentheses are 95% confidence intervals.

‡ Data are means ± standard deviations.

Table 4

Distribution of Residual Labral Tears in Asymptomatic and Symptomatic Patients

	Reader 1		Reader 2	
Labral Tear Position	Asymptomatic Group ($n = 17$)	Symptomatic Group ($n = 17$)	Asymptomatic Group ($n = 17$)	Symptomatic Group ($n = 17$)
Anterior	24 (4)	24 (4)	24 (4)	29 (5)
Anterosuperior	12 (2)	24 (4)	24 (4)	12 (2)
Superior	0 (0)	0 (0)	12 (2)	29 (5)
Posterosuperior	6 (1)	6 (1)	29 (5)	24 (4)
Posterior	6 (1)	6 (1)	0 (0)	6 (1)

Note.—Data are percentages, with numbers of patients in parentheses.

Table 5

Distribution of Acetabular and Femoral Cartilage Defects in Asymptomatic and Symptomatic Patients

	Reader 1		Reader 2	
Position	Asymptomatic Group ($n = 17$)	Symptomatic Group ($n = 17$)	Asymptomatic Group ($n = 17$)	Symptomatic Group ($n = 17$)
Acetabular cartilage defects				
Anterior	0 (0)	0 (0)	0 (0)	0 (0)
Anterosuperior	6 (1)	6 (1)	30 (5)	47 (8)
Superior	6 (1)	24 (4)	18 (3)	24 (4)
Posterosuperior	6 (1)	6 (1)	6 (1)	0 (0)
Posterior	0 (0)	0 (0)	0 (0)	0 (0)
Femoral cartilage defects				
Anterior	6 (1)	6 (1)	6 (1)	6 (1)
Anterosuperior	6 (1)	6 (1)	6 (1)	12 (2)
Superior	0 (0)	6 (1)	12 (2)	12 (2)
Posterosuperior	0 (0)	6 (1)	0 (0)	0 (0)
Posterior	0 (0)	0 (0)	0 (0)	0 (0)
Inferior	0 (0)	6 (1)	0 (0)	0 (0)

Note.—Data are percentages, with numbers of patients in parentheses.

of symptomatic patients (two of 17 patients) by reader 1 and in 6% of asymptomatic patients and 18% of symptomatic patients by reader 2 ($P = .25$). In our patient groups, we did not find any femoral neck fractures or avascular necrosis of the femoral head.

A fluid-filled iliopsoas bursa (Figs 7, 8) was detected in 41% of asymptomatic patients (seven of 17 patients) and 35% of symptomatic patients (six of 17 patients) by both readers, without a statistically significant difference between both groups ($P = .62$).

Interobserver agreement between reader 1 and reader 2 has been included in Table 6.

Discussion

The results of our study showed that, 1 year after arthroscopic treatment of FAI, the obliteration of the paralabral sulcus was the most frequent finding at MR arthrography and was detected in almost all individuals in both the asymptomatic and symptomatic groups. Capsular adhesions at the anterior femoral neck were seen in an equal number of asymptomatic and symptomatic patients (approximately one-third of individuals).

In the past decade, arthroscopic hip surgery has become the standard surgical therapy for FAI (8,16–19). A recent study on arthroscopic treatment of FAI (20) reported that 82% of patients (236 of 289 patients) were satisfied with the surgical result after 2 years.

Although postoperative complications of arthroscopic hip surgery are infrequent and good outcome data have been reported, some patients have residual hip or groin pain after surgery (8,21–23). Severe postoperative complications after arthroscopic hip surgery (eg, avascular necrosis of the femoral head or femoral neck fractures) are known but rare (8,22,24). However, there are a variety of less severe postoperative complications, such as capsular adhesions at the femoral neck, capsular defects, obliteration of the paralabral sulcus, labral tears, and cartilage defects of the femoral head and acetabulum.

It is a challenge for the orthopedic surgeon to choose appropriate conservative treatment methods or decide whether revision hip surgery is necessary in patients with FAI after so-called failed hip surgery (9,12,13). These patients usually undergo a dedicated medical work-up that includes imaging. Accordingly, radiographic and MR imaging findings play a role in the decision-making process to indicate the appropriate treatment in failed hip surgery.

To our knowledge, only limited original data on postoperative MR arthrographic findings after arthroscopic hip surgery have been published so far: Blankenbaker et al (14) demonstrated a shortening of the labrum as a typical appearance after arthroscopic hip surgery with partial resection of the labrum and detected recurrent labral tears in 70% of patients (14 of 20 patients) at MR arthrography. In our study, residual labral tears were found 20%–30% less frequently than in the study by Blankenbaker et al, but, notably, the residual labral tears in our study population occurred at the same frequency in both

Table 6

Measure of Agreement

Parameter	Measure of Agreement
Capsular adhesions	0.74
Adhesion size	0.78*
Paralabral sulcus	NA
Labrum	0.44
Labral tear	0.25
Labrum morphology	0.41
Capsular defects	0.65
Capsular defect size	−0.13*
Acetabular cartilage	0.35
Femoral cartilage	0.53
Edema in acetabulum	1.00
Edema in femoral head	0.84
Fluid-filled iliopsoas bursa	0.88

Note.—Except where indicated, data are κ values. NA = not applicable, reader 2 detected an obliterated paralabral sulcus in one or more location in all patients.

* The intraclass correlation coefficient was calculated for continuous variables.

the asymptomatic and symptomatic patients. As reported by Blankenbaker et al (14), we also found that most labral tears were located in the anterior, anterosuperior, and superior positions and fewer were located in the posterosuperior or posterior position. A number of labral tears found in our study may have been present even before surgery; therefore, we decided to call these "residual" labral tears. However, it is known from studies of patients undergoing revision hip arthroscopy that labral repairs and additional labral débridement is often performed during revision surgery (25), so some of the labral tears found are actually clinically relevant labral tears. However, our study design did not allow us to further investigate the relevance of these labral tears. Furthermore, we detected a shortened labrum with a high frequency (82% and 88%) in both asymptomatic and symptomatic patients, compared with 100% of patients (20 of 20 patients) in the study by Blankenbaker et al (14).

Capsular adhesions at the femoral neck, along the labrum and the joint capsule, after hip surgery consist of scar tissue. These adhesions have been suspected as an important cause of soft-tissue impingement, restricted range of motion, and pain after hip arthroscopy (9,26). In a recent cohort study (25), painful adhesions were seen at revision surgery in nine of 42 patients (21%) who underwent arthroscopic hip surgery. As a consequence, capsular adhesions are a common reason for revision surgery (9,12,13). In our study population, however, capsular adhesions were a common finding and showed no difference in frequency between the asymptomatic and symptomatic groups. Our results are in accordance with those of other studies that showed that adhesions are common (12). Yet, whereas other studies reported that surgical removal of capsular adhesions may alleviate pain after previous hip surgery (26), our study is, to our knowledge, the first to show that asymptomatic patients after hip arthroscopy also often have intraarticular adhesions, which indicates that these adhesions need not always cause groin pain.

We further noted postoperative adhesions between the joint capsule and the labrum, and these may tether the labrum to the capsule, resulting in obliteration or bandlike adhesions of the paralabral sulcus and thus affecting the sealing function of the labrum (9). In our study, such paralabral bandlike adhesions or obliteration of the paralabral sulcus in at least one position were also common and showed no difference between the asymptomatic and symptomatic groups.

Defects of the anterior capsule have been described as another possible reason for hip pain or hip instability (27,28). Nevertheless, in our study we showed that capsular defects are even more frequent in asymptomatic patients than in symptomatic patients. It was proposed that postoperative defects of the anterior joint capsule are related to capsulotomy and capsulectomy during the surgical intervention (24,27). The clinical relevance of these joint capsule defects is discussed controversially in the literature (24,27); however, the results of our study suggest that a number of these capsular defects are clinically unimportant 1 year after hip arthroscopy.

Harris et al (8) reported iatrogenic chondral lesions during portal placement or during exchange of instruments (so-called "scope trauma") as the most common complication of hip arthroscopy but reminded that a steep learning curve as described by Konan et al (29) may significantly reduce such complications. In our study population, we did not find an increased number of acetabular or femoral cartilage defects in the symptomatic group compared with the asymptomatic group. Furthermore, no scope trauma was seen in our study population.

The limitations of our study are related to the relatively small number of patients who underwent postoperative MR arthrography and the lack of surgical correlation. The reason for this is that it is difficult to obtain MR arthrography data 1 year after hip arthroscopy, especially in asymptomatic patients. However, the limited number of patients in our study does not alter the fact that a variety of abnormal imaging findings were present in the asymptomatic individuals and that these postoperative changes were nearly uniformly distributed between asymptomatic and symptomatic individuals.

Almost all postoperative changes we reviewed were evenly distributed between the asymptomatic and symptomatic groups and showed no tendency to occur more frequently in the symptomatic patient group. One notable exception was that labrum resection was more commonly performed in the asymptomatic patients than in the symptomatic patients, even though this difference was not statistically significant. However, our study size may be too small to observe such a difference. Thus, we conclude from our data that postoperative changes after arthroscopic hip surgery, including capsular adhesions or defects, obliteration of the paralabral sulcus, or residual labral tears, are typical imaging findings and do not occur more commonly in symptomatic patients. In summary, seemingly abnormal imaging findings after arthroscopic hip surgery were common in both asymptomatic and symptomatic patients, with a uniform distribution

between both groups. We conclude that these findings do not necessarily correlate with postoperative hip pain.

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